Colour Management Method (CMM) which maintains CIELAB hue, relative lightness and chroma for analog and digital ISO/IEC-test charts

www.ps.bam.de/WAG05.PDF

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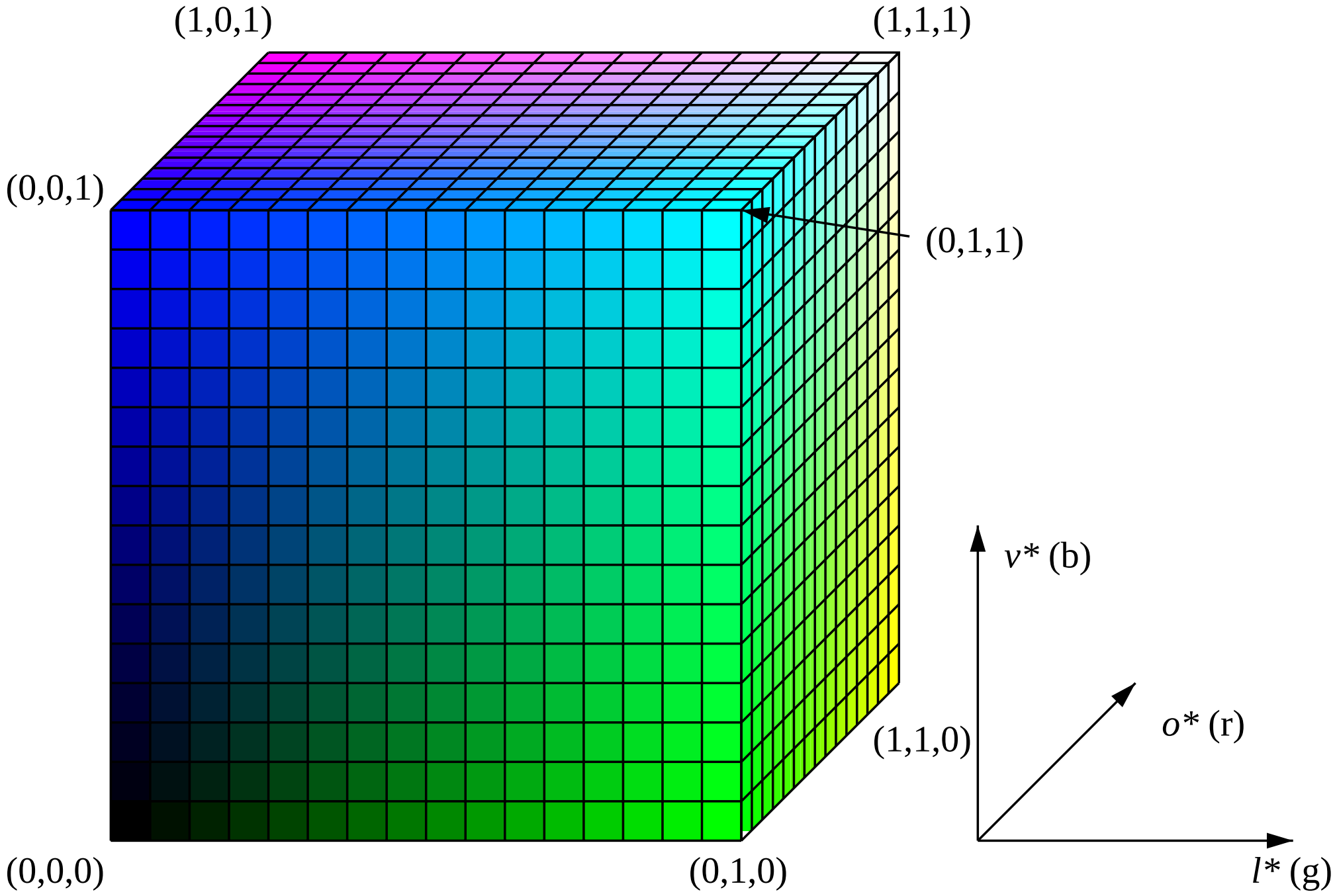
Overview

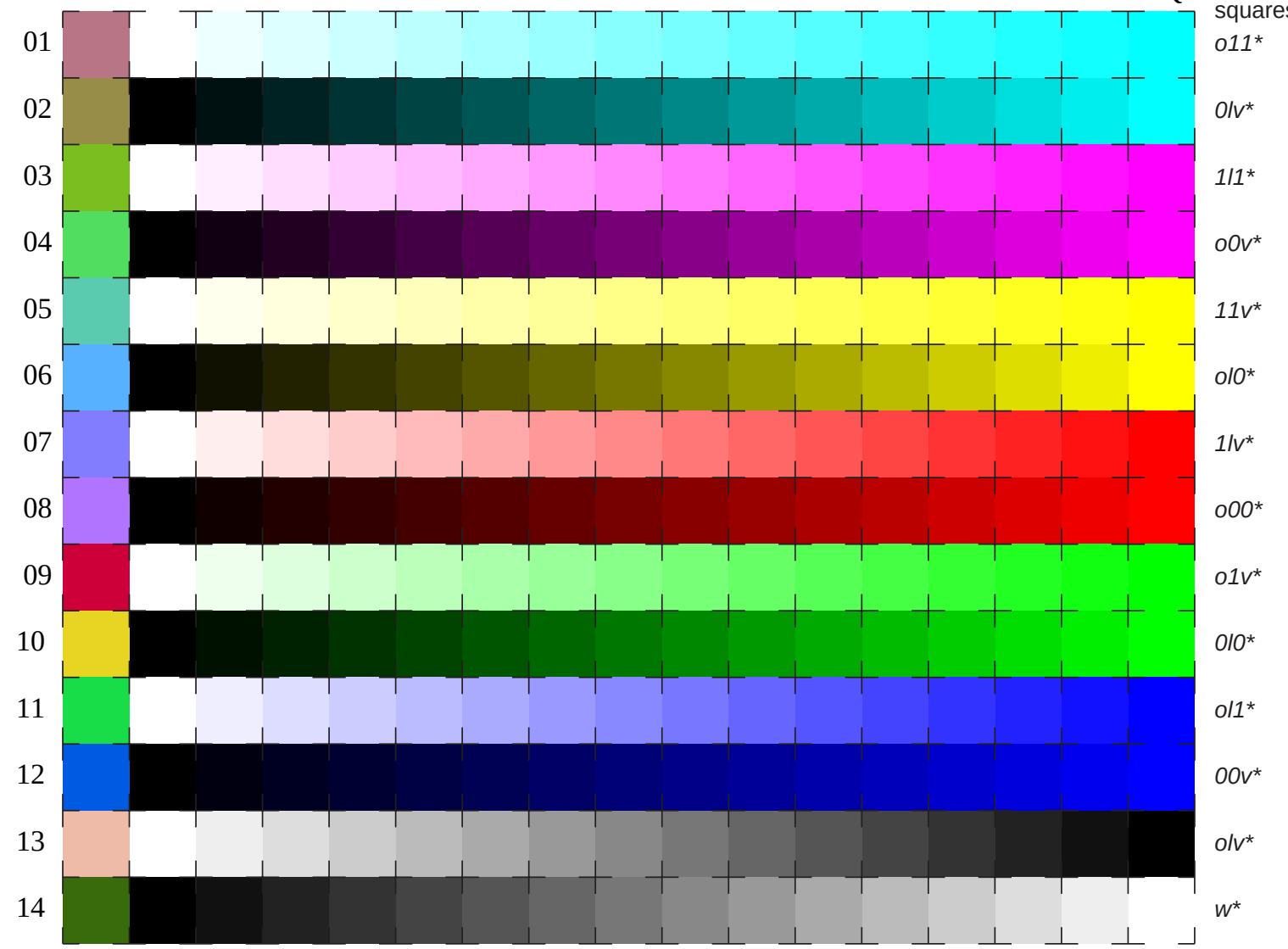
- A typical workflow and it's problems
- Introduction of the Natural Colour Connection Space (NCCS)
- Definition of a linear relationship between *olv** (*rgb*) values and the coordinates of the NCCS
- Correlation between the coordinates of the NCCS and the CIELAB data of a special device
- Definition of a suitable Testchart for a practicle workflow
- 2nd output (printout) of calculated *olv'** values
- Summary & outlook

Definition of the RGB cube, definition range, characteristics



Workflow: 16 step colour scales, printout -> CIELAB data

www.ps.bam.de/LE01/10L/L01E00NP.PS/.PDF; start output
N: No Output Linearization (OL) data File, Startup (S) or Device (D)



used coordinate squares

*o11**
*0lv**
*1l1**
*o0v**
*11v**
*ol0**
*1lv**
*o00**
*o1v**
*0l0**
*ol1**
*00v**
*olv**
*w**

See for similar files: http://www.ps.bam.de/LE01/
Information and Order: http://www.ps.bam.de/ Version 2.0, io=0,0; iORS; oORS, CIELAB

BAM registration: 20042210-LE01/10L/L01E00NP.PS/.PDF
application for measurement of monitior (Yr=2.5) and printer

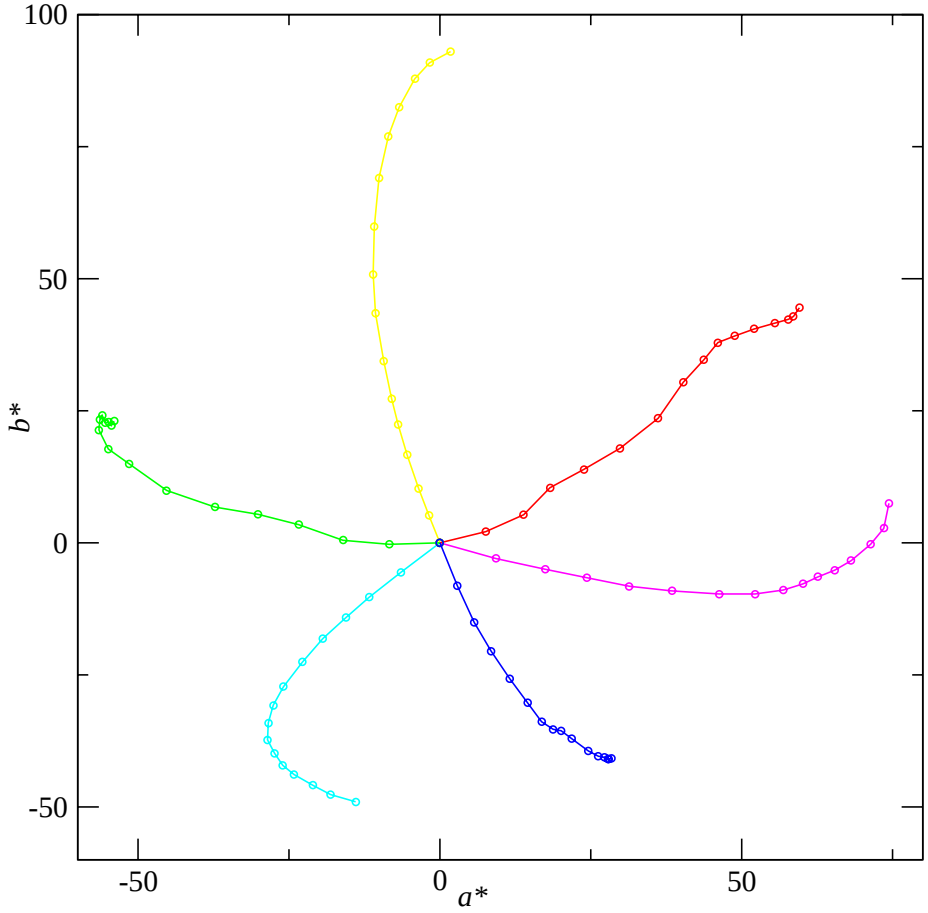
BAM material: code=rha4ta

16 equidistant CIELAB steps: *2 x C−B, M−B, M−R, Y−R, Y−G, C−G, B−W cmy0, W−B rgb* and 14 CIE-test colours in CMYK defined (left)

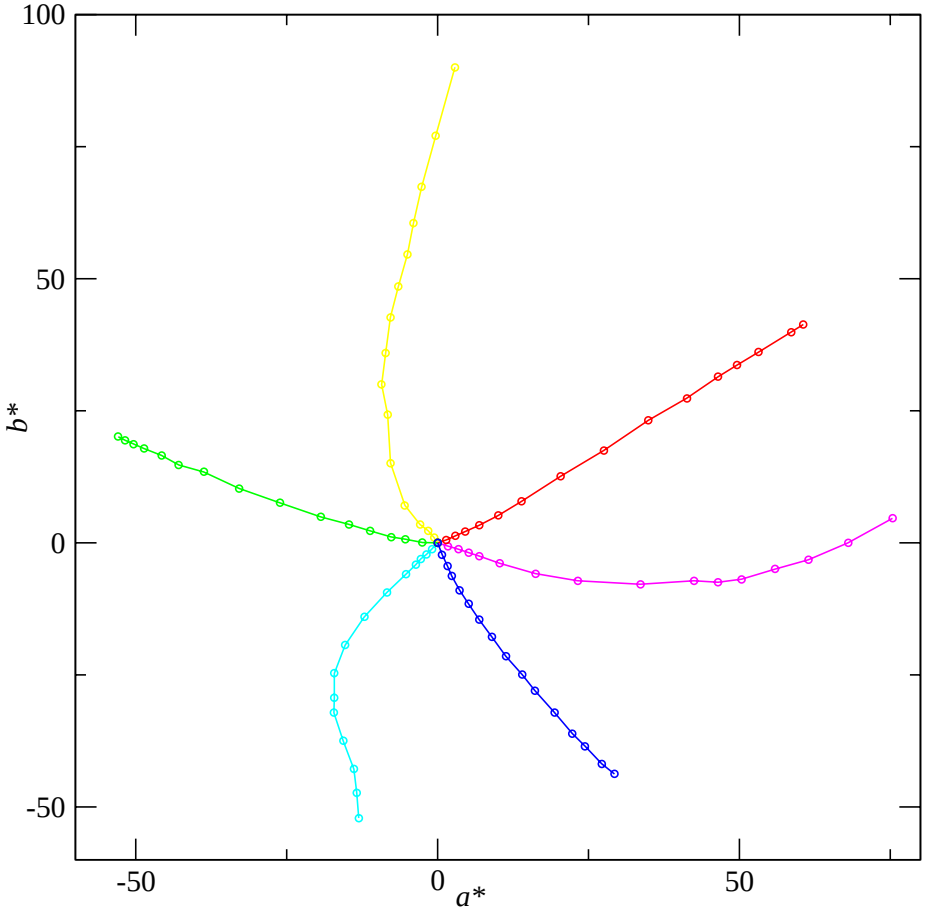
Test chart LE01: 16 CIELAB steps of ISO/IEC 15775
Chromatic-White, Chromatic-Black, Black-White

input(ORS18): *olv* setrgbcolor*
output(ORS18): *no change compared to input*

a−b** projection of printer output, 16 step colour scales *W-Colour*



a−b** projection of printer output, 16 step colour scales *N-Colour*

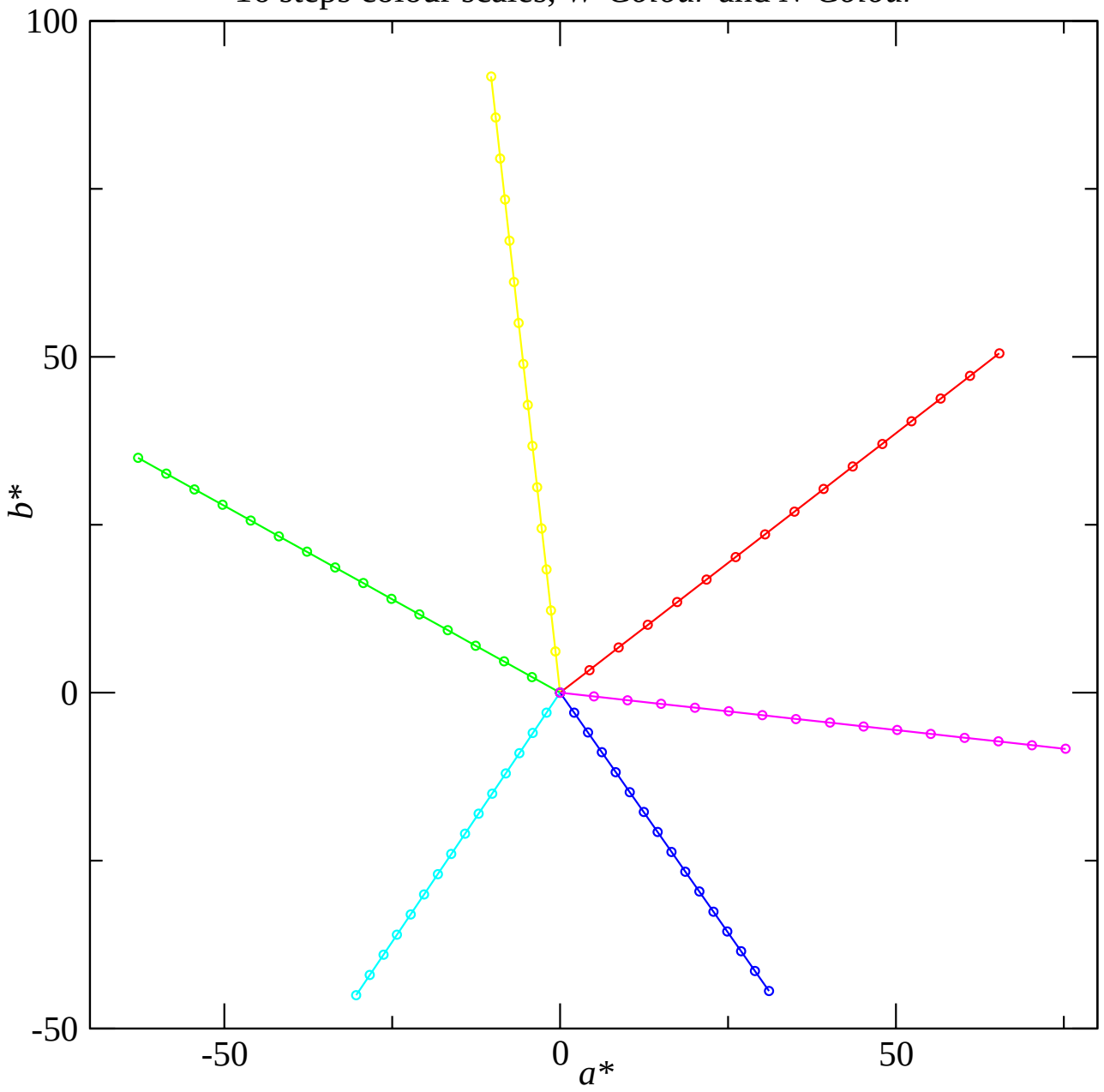


Problems:

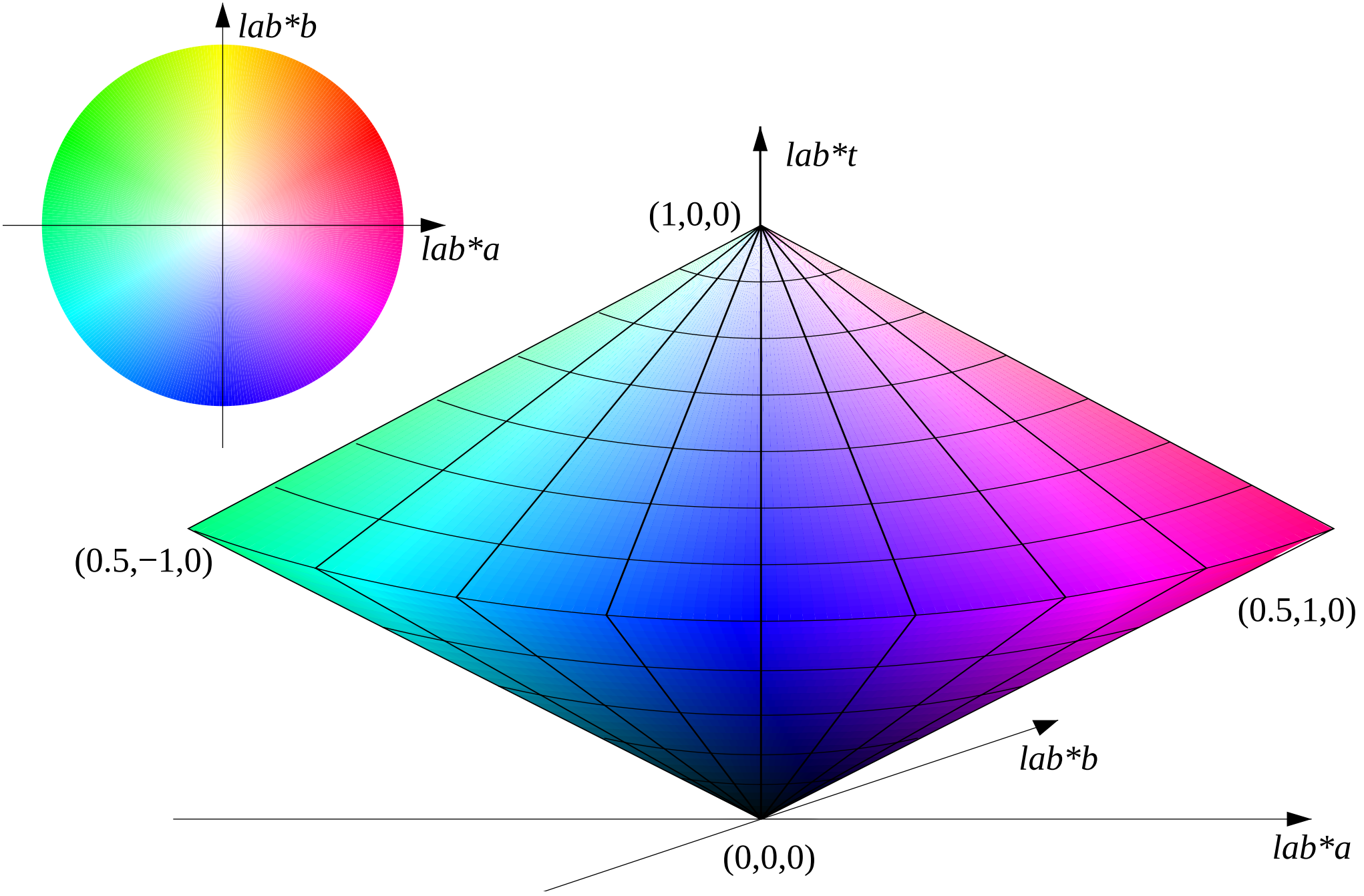
- no constant hue
- big differences in ΔE spacing of colour scales
- maximum chromaticness is not well defined

goal of a-b projection

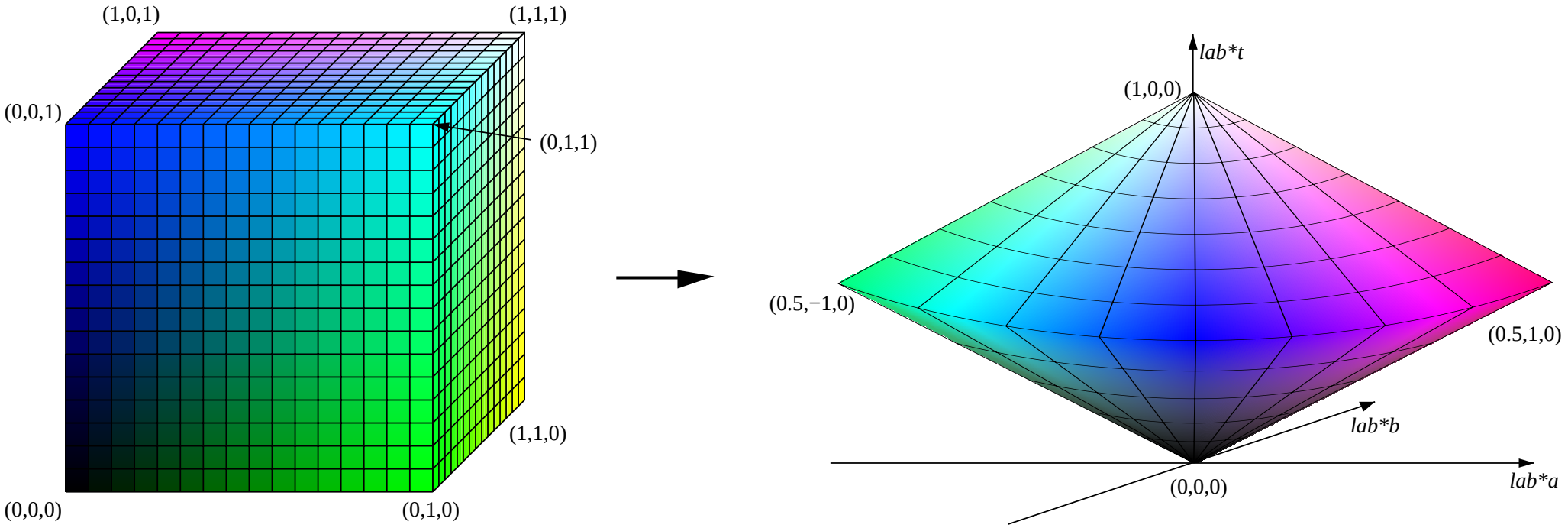
intention: a^*-b^* projection of linearised printer output
16 steps colour scales, *W-Colour* and *N-Colour*



Double cone - NCCS

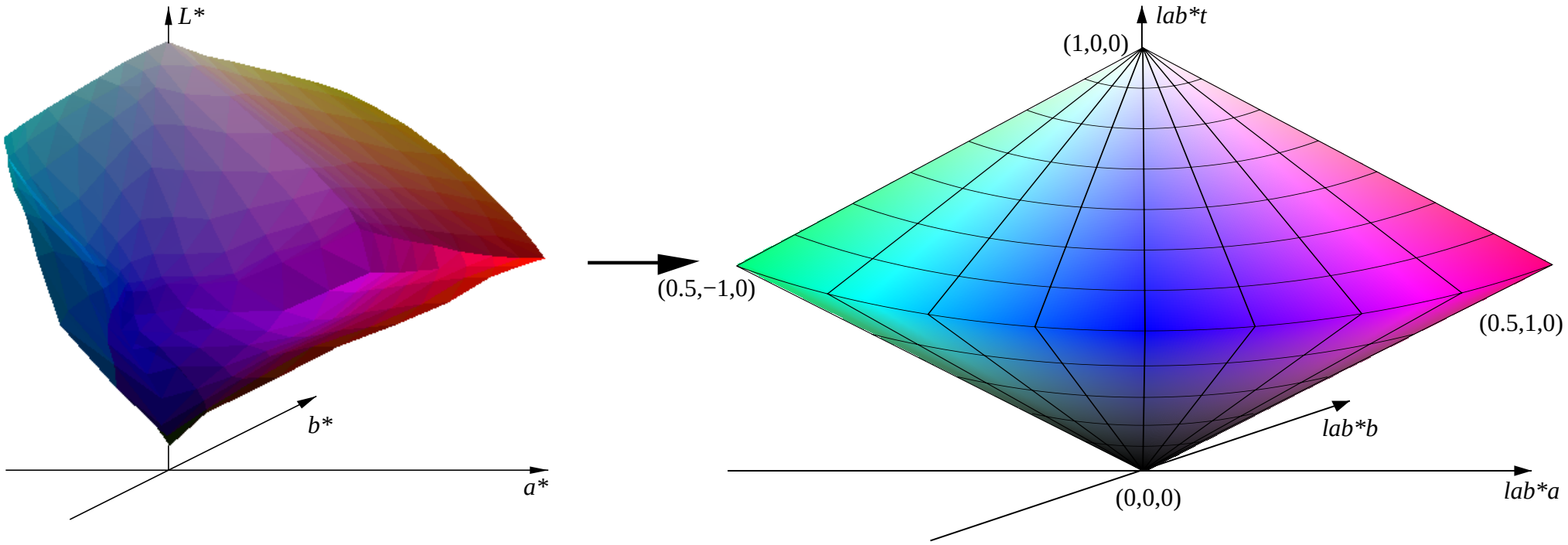


Connection of RGB cube with NCCS



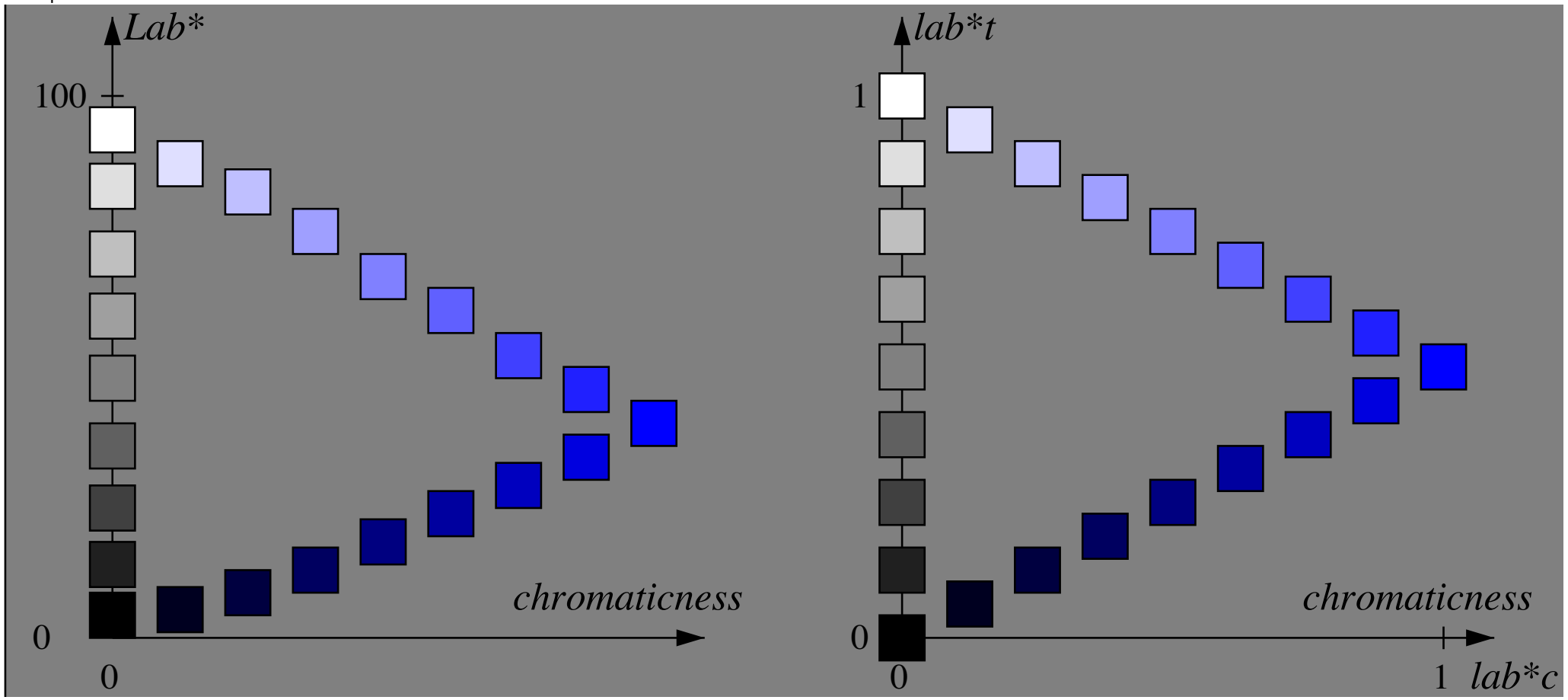
- definition and calculation of three relative coordinates *lab*tab* or *lab*tch* - similar to the Natural Colour System (NCS)
- *lab*tab*: triangle ligthness, red-green and blue-yellow chromaticness
- *lab*tch*: triangle ligthness, chromaticness and hue

Definition of the coordinates of the NCCS



- *Lab** (left) transform to *lab*tab* (right):
- Lab_n* -> $lab*tab_n$=(0,0,0); Lab_W*->$lab*tab_W$=(1,0,0)
- find for each hue the coordinates in *Lab** of maximum chromaticness such that ($lab*a^2$+$lab*b^2$)=1 and *lab*t*=0.5

Example of Transformation *Lab** to *lab*tab*



- transformation for equal hue from *Lab** to *lab*tab*
- relative spacing of next neighbours is equal

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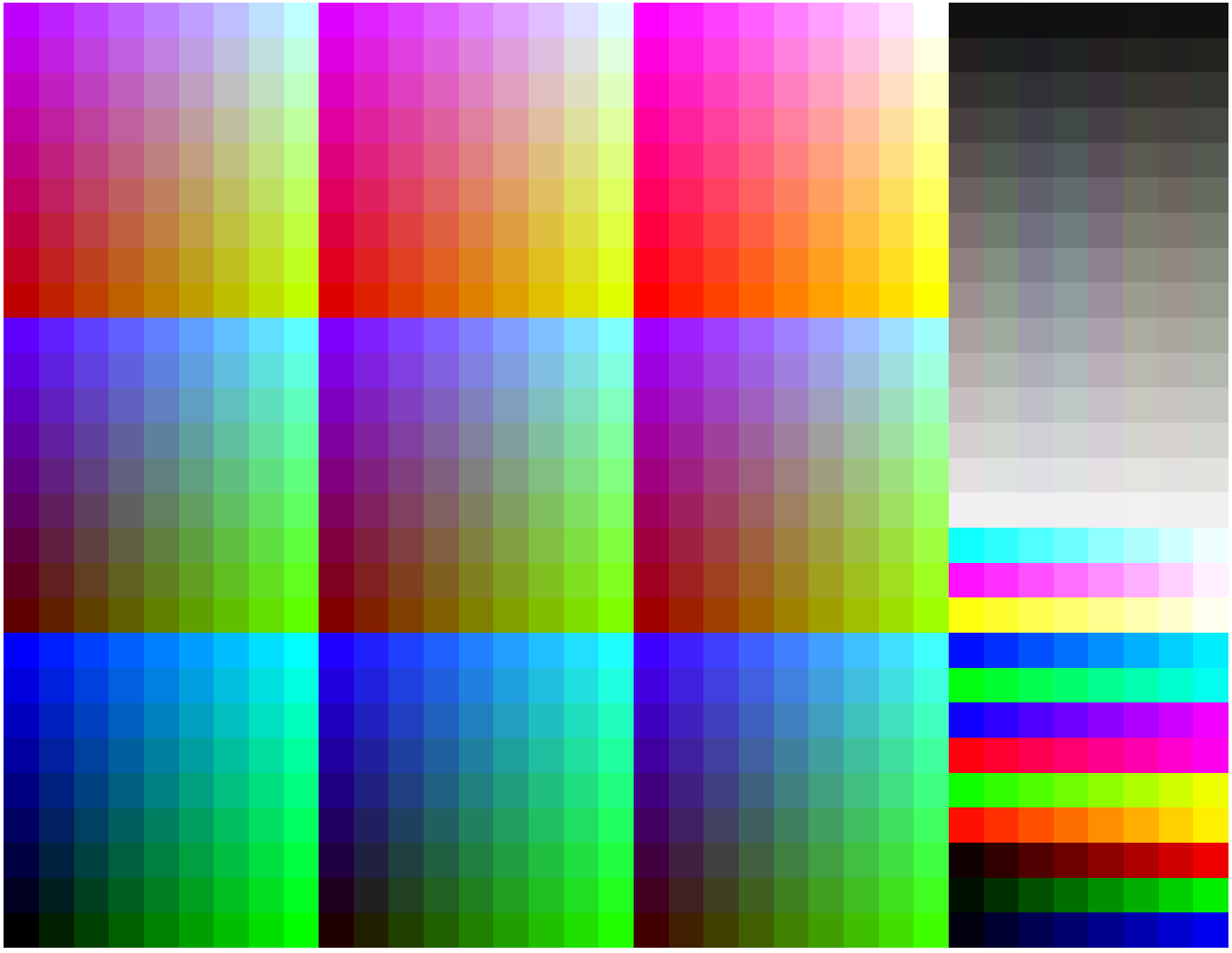
Defintion of a Testchart for a practicle workflow

www.ps.bam.de/ME21/10L/L21E00NP.PS/.PDF; start output
N: No Output Linearization (OL) data in File (F), Startup (S) or Device (D)



See for similar files: http://www.ps.bam.de/ME21/ME21.HTM
Information and Order: http://www.ps.bam.de Version 2.0, io=1,1

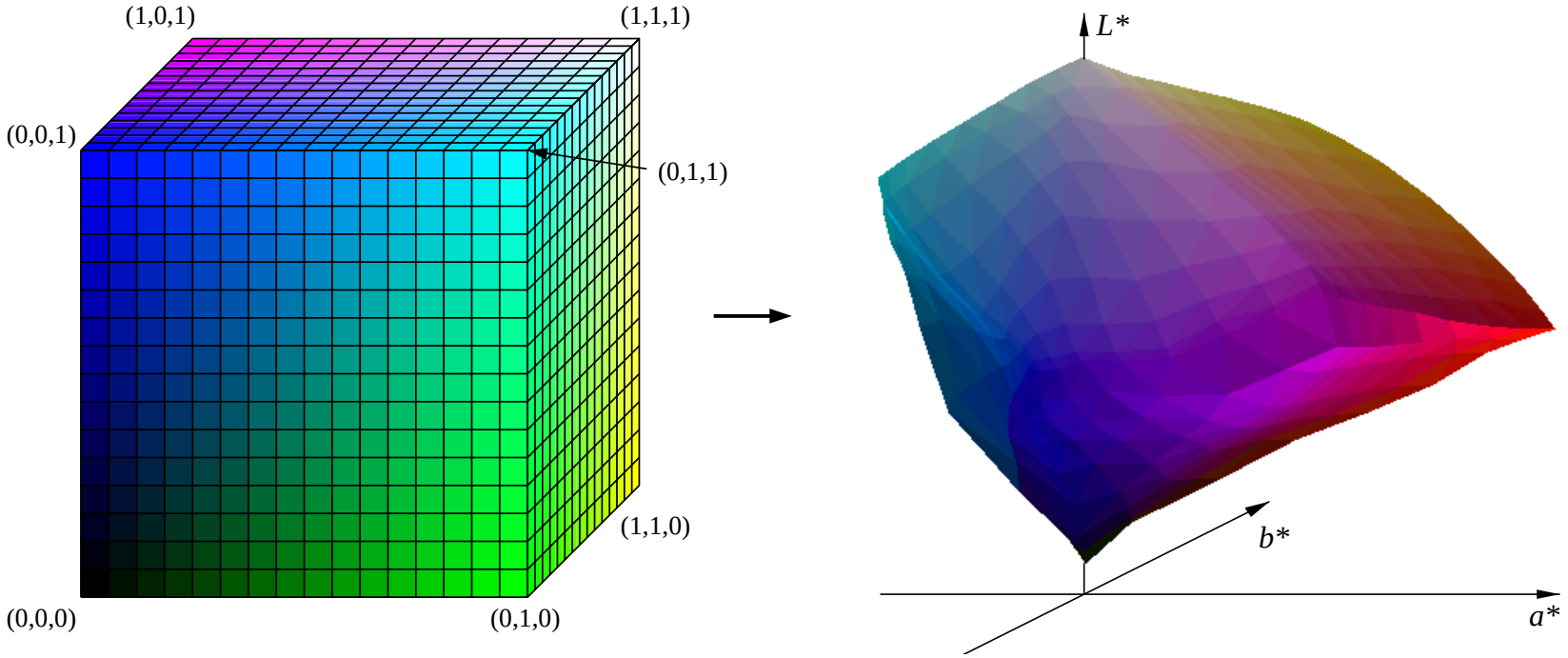
BAM registration: 20030101-ME21/10L/L21E00NP.PS/.PDF BAM material: code=rha4ta
application for measurement of monitor (Yr=2.5) and printer output

9x9x9 colour cube and colour tinted grey scales, hue circle with maximum chromaticness and *W−CMY, OLV−N*

Test chart ME21: 9x9x9 colour cube and grey scales
Hue circle and colour series *W−CMY, OLV−N*

input(ORS18): *olv* setrgbcolor*
output(ORS18): *no change compared to input*

Measurment result



- first output of *olv** values intents *Lab** values but gives *Lab*'* values which are device dependent
- calculation of *olv'** values for the intended *Lab** values
- 2nd output of the *olv'** values, 2nd measurement of *Lab**
- check of accuracy

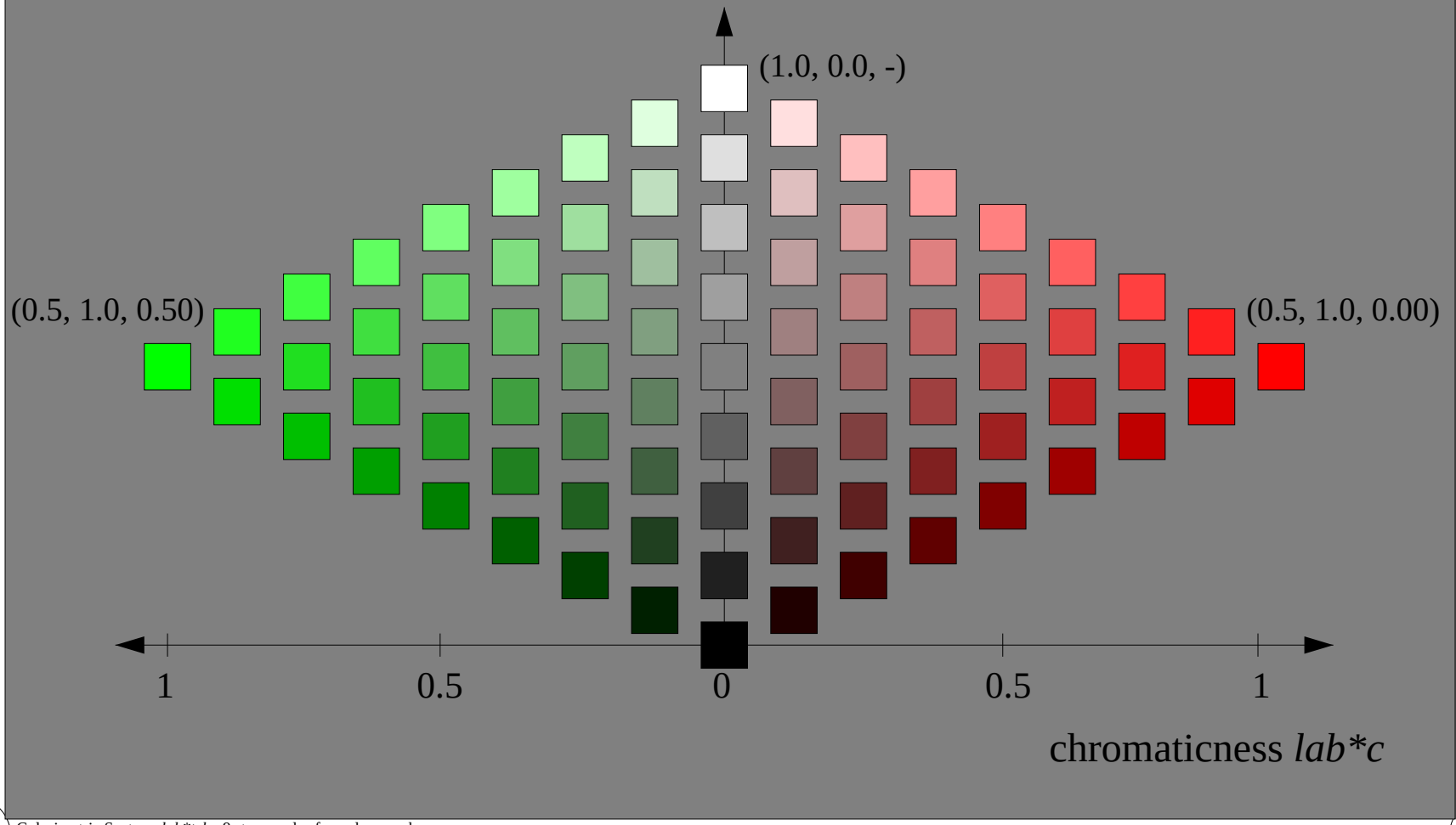
9 step colour scales for rec-green hue

www.ps.bam.de/ME21/10L/L21E02NP.PS/.PDF; start output
N: No Output Linearization (OL) data File, Startup (S) or Device (D)

See for similar files: http://www.ps.bam.de/ME21/ME21.HTM
Information and Order: http://www.ps.bam.de/ Version 2.0, io=0,0; iORS; oORS, CIELAB

BAM registration: 20053103-ME21/10L/L21E02NP.PS/.PDF BAM material: code=rha4ta
application for measurement of monitor (Yr=2.5) and printer

Colorimetric System
*lab*tch*



Colorimetric System: *lab*tch* , 9 steps scales for red−green hue

Test chart ME21: Colorimetric System *lab*tch*
9 steps scales for red-green hue

input(ORS18): *olv* setrgbcolor*
output(ORS18): *no change compared to input*

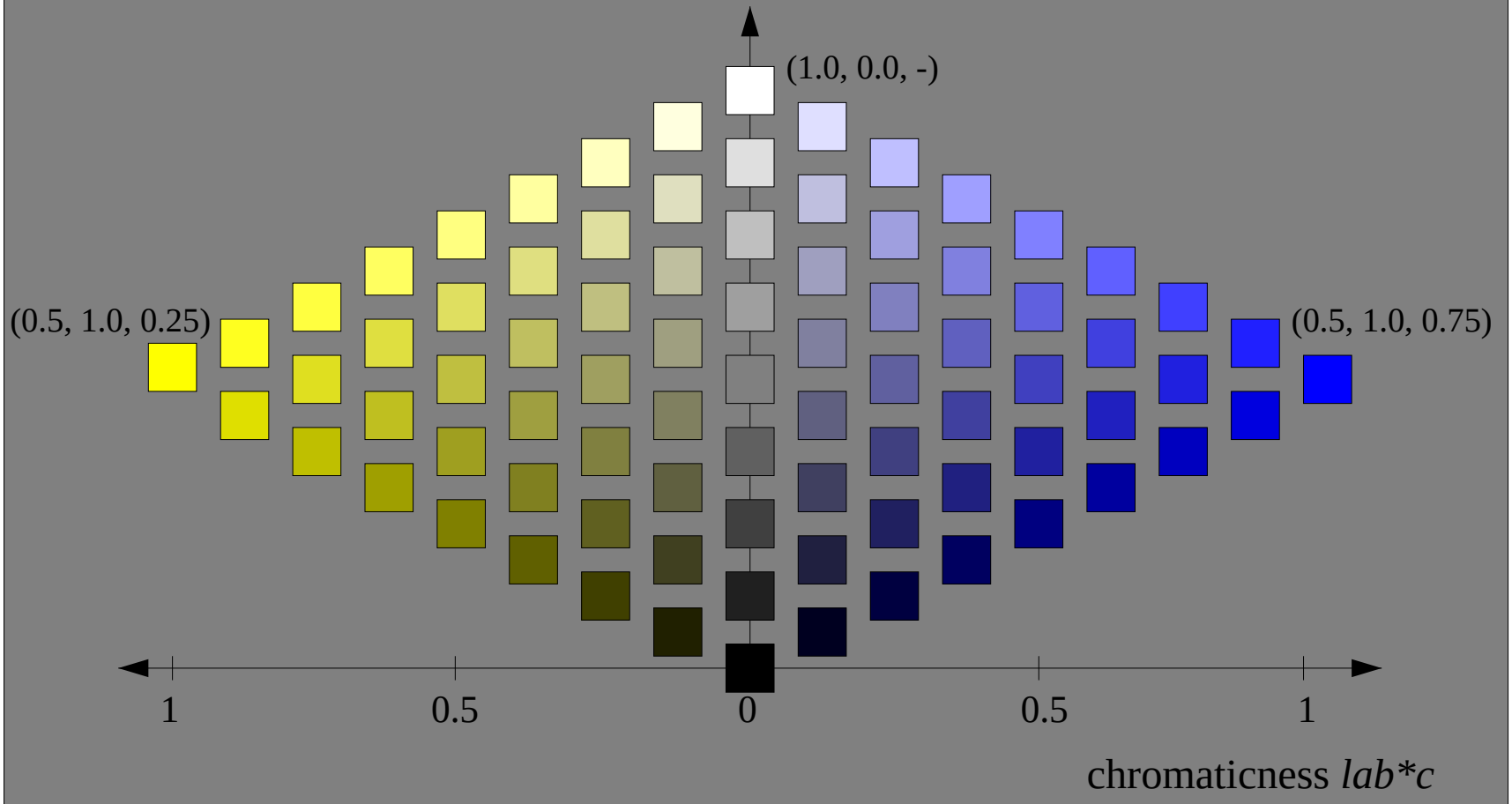
9 step colour scales for blue-yellow hue

www.ps.bam.de/ME21/10L/L21E03NP.PS/.PDF; start output
N: No Output Linearization (OL) data File, Startup (S) or Device (D)

See for similar files: http://www.ps.bam.de/ME21/ME21.HTM
Information and Order: http://www.ps.bam.de/ Version 2.0, io=0,0; iORS; oORS, CIELAB

BAM registration: 20053103-ME21/10L/L21E03NP.PS/.PDF BAM material: code=rha4ta
application for measurement of monitior (Yr=2.5) and printer

Colorimetric System
*lab*tch*



Colorimetric System: *lab*tch* , 9 steps scales for blue−yellow hue

Test chart ME21: Colorimetric System *lab*tch*
9 steps scales for blue-yellow hue

input(ORS18): *olv* setrgbcolor*
output(ORS18): *no change compared to input*

summary & outlook

- a new CMM using the NCCS was presented
- the method is device independent
- the transformation from the double cone to *Lab** is such that the complete CIELAB space of a certain devise is used
- linear relationship between input *olv** (*rgb**) data and output CIELAB data is fulfilled

- special functions such as dynamic definition of hue or shift of chromaticness according to a desired output is possible